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THE EFFECT OF REINFORCER PREFERENCE ON FUNCTIONAL ANALYSIS OUTCOMES

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We combined functional analyses and concurrent-schedule assessments to identify reinforcer preference during situations in which problem behavior may have been multiply controlled. Participants were 3 children with developmental delays who engaged in problem behavior during toy play with another child and one adult present, suggesting that problem behavior may have been maintained by adult attention or access to tangible reinforcement. Thus, conditions were designed to test attention and access-to-toys hypotheses. Initial functional analyses suggested multiple control. Subsequent concurrent-schedule assessments identified preference between the reinforcers, and treatments were based on these findings. Findings are discussed regarding the assessment of potentially multiply controlled problem behavior.

DESCRIPTORS: functional analysis, aggression, self-injury, multiply controlled problem behavior, concurrent-schedule design

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Functional analysis methodology has helped therapists to develop treatments based on the function of problem behavior. Typically, analogue conditions are developed in which a specific establishing operation is controlled (i.e., deprivation of attention or items or presentation of aversive stimulation) and a presumed reinforcer is delivered (or an aversive stimulus is removed) contingent on the occurrence of problem behavior (e.g., Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). Reliable responding correlated with an establishing operation suggests behavioral function. The functional analysis model has proven to be a reliable assessment for providing valid data on the environmental determinants of problem behavior. However, behavioral function may be more difficult to identify in the presence of potential multiple establishing operations (Lalli & Casey, 1996) or when multiple control may be indicated (e.g., Day, Horner, & O'Neill, 1994; Smith, Iwata, Vollmer, & Zarcone, 1993).

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Lalli and Casey (1996) showed the potential complexity of assessing and treating problem behavior that occurs in the presence of potential multiple controlling stimuli. A descriptive analysis showed that a child's aggressive behavior occurred most frequently when his mother's instruction ended toy play with the mother (i.e., a preferred activity) and initiated picking up the toys (i.e., a nonpreferred activity). In this situation, it was difficult to determine whether the child was responding to continue interactive toy play (i.e., positive reinforcement) or to avoid the demand (i.e., negative reinforcement; Iwata, 1987). The functional analysis clearly showed that aggression was maintained by attention, but results for toys and escape were less conclusive. The initial treatment (during a task) showed that allowing a break with access to toys on a rich fixed-ratio (FR) schedule for compliance (FR 1) reduced aggression compared to baseline. However, aggression returned to baseline rates when the schedule was changed to an FR 2. Persistent decreases in aggression were obtained only when compliance with an instruction produced a break with access to attention and toys. These findings suggested that aggression was sensitive to contingent access to attention and toys, and escape from demands during this situation. A functional analysis condition that provided the combination of reinforcers rather than the individual reinforcers may have helped to clarify behavioral function.

In the present study, we encountered a situation similar to that found by Lalli and Casey (1996). Descriptive analyses (Mace & Lalli, 1991) showed that problem behavior most frequently occurred when 2 children were playing with toys in the presence of an adult. Additional analyses showed that attentive reactions from the adult and access to a toy typically followed problem behavior. Thus, it was difficult to determine whether problem behavior was influenced by adult attention or access to a toy because both were available concurrently. Therefore, we needed to design conditions (a) to test the problem behavior's sensitivity to either attention or toys as reinforcers, or (b) to identify participants' preference between attention and toys when available concurrently. The current study was conducted across three phases for each participant. In Phase 1, we assessed participants' problem behavior via functional analyses. In Phase 2, we conducted additional concurrent-schedule assessments to test the problem behavior's sensitivity to attention or materials (i.e., toys) as potential reinforcers. In Phase 3, we assessed the effects of treatments based on the assessment results from Phase 2.

METHOD

Participants and Setting

Participants were 3 children with mild developmental delays who had been admitted to a hospital inpatient unit specializing in the treatment of severe problem behavior. Dave was 2.5 years old and was admitted for treatment of self-injurious (SIB) and aggressive behavior. Past efforts to manage his aggression included physical restraint (holding his arms in front of him), reprimands, and response cost. Dave wore a helmet throughout the day (except during bathing and sleeping) upon admission to reduce the likelihood of injury resulting from his SIB (head banging). He communicated using one-word utterances and required hand-over-hand assistance to complete all self-care activities. Dave lived at home with his parents, a younger brother (10 months old), and an older sister (4 years old). Carter was 3.5 years old and was admitted for treatment of aggressive and disruptive behavior. His mother managed these behaviors with physical restraint (holding his hands and arms in front of him) and reprimands. He communicated using one-word utterances and required minimal hand-over-hand assistance to complete his self-care. Carter lived at home with his mother and his brother (2 years old). Dan was 3 years old and was admitted for SIB and aggressive behavior. Past efforts to manage his SIB and aggression included reprimands and time-out. He communicated using one-word utterances and required hand-over-hand assistance to complete self-care activities. Dan lived with his mother and two brothers (5 years old and 1 year old).

All sessions were conducted in a dormitory-style room (4.5 m by 6.0 m) that served as the participants' living quarters during their admissions. The room was equipped with a bathroom, a sofa, a table, and three to five chairs. A therapist, a participant, and another child (during the modified functional analyses and concurrent-schedule assessments and treatments) were present during sessions, and observers recorded data from behind a one-way mirror. Participants' admissions were sequential.

Dependent Variables and Data Collection

Self-injurious behavior was defined as forceful contact of his head to a stationary object (Dave and Dan) or closure of the upper and lower teeth on his hand or arm (Dan). *Aggression* was defined as forceful contact of his head (Dave and Dan) or hand (Carter) on a body part of another person, or closure of the upper and lower teeth on any body part of another person (Dan). *Disruption* was defined as throwing or knocking objects off furniture (Carter). Data were also collected on the therapist's praise, removal of task-related materials, reprimands, and provision of toys to monitor procedural fidelity. Four to five 10-min sessions were conducted daily for each participant, 5 days per week during all phases of the study.

Observers used a computerized event-recording procedure for all topographies (Repp, Harman, Felce, VanAcker, & Karsh, 1989). A second observer independently collected data during an average of 20% of the sessions, equally distributed across all phases and participants. Interobserver agreement was determined using the "reliable" program (Repp et al., 1989). Occurrence agreement was scored when two observers recorded the onset of a target behavior within 2 s of each other. Occurrence agreement averaged 96% (range, 88% to 100%) across topographies, phases of the study, and participants. Procedural fidelity data showed that the therapist correctly carried out the procedures on an average of 95% of the opportunities across all participants.

PHASE 1: FUNCTIONAL ANALYSIS

Experimental Design and Procedure

We assessed participants' problem behavior via a functional analysis (Iwata et al., 1982/1994) within a multielement design, with additional attention sessions conducted for Carter and Dan to achieve stability. For the functional analysis, the therapist provided either attention, escape, or access to a toy contingent on each occurrence of a participant's SIB, aggression, or disruption during the relevant conditions. In the attention condition, the therapist provided the participant with a requested item and interacted with him for 2 to 3 min before diverting his or her attention to paperwork. The therapist then provided disapproving comments contingent on each occurrence of problem behavior. During the escape condition (self-care), the therapist provided (a) an instruction to the participant once every 30 s using a three-step prompt sequence (i.e., verbal, gesture, physical), (b) descriptive praise for correct responses, and (c) a 30-s break from the task (escape) contingent on each occurrence of problem behavior. In the materials condition, the therapist provided the participant with access to his preferred object for approximately 2 min. Then, the therapist removed the object and provided the participant with other age-appropriate toys. Preferred objects were placed in the participant's view but out of reach. The therapist provided descriptive praise contingent on appropriate toy play and neutral comments on a fixed-time (FT) 30-s schedule. Contingent on each occurrence of problem behavior, the therapist returned the object for 30 s. The participants' parents identified the objects that had been correlated with problem behavior in their homes for use in this condition. In the control condition, the therapist provided access to requested items, descriptive praise for appropriate toy play, and neutral comments on an FT 30-s schedule. The therapist did not respond to problem behavior during this condition. In the alone condition, the participant was placed in a room without toys or adults. This condition was designed to assess whether SIB persisted in the absence of social stimulation.

Results

Figure 1 shows the results of the functional analysis for each participant. Data on each participant's problem behaviors (e.g.,

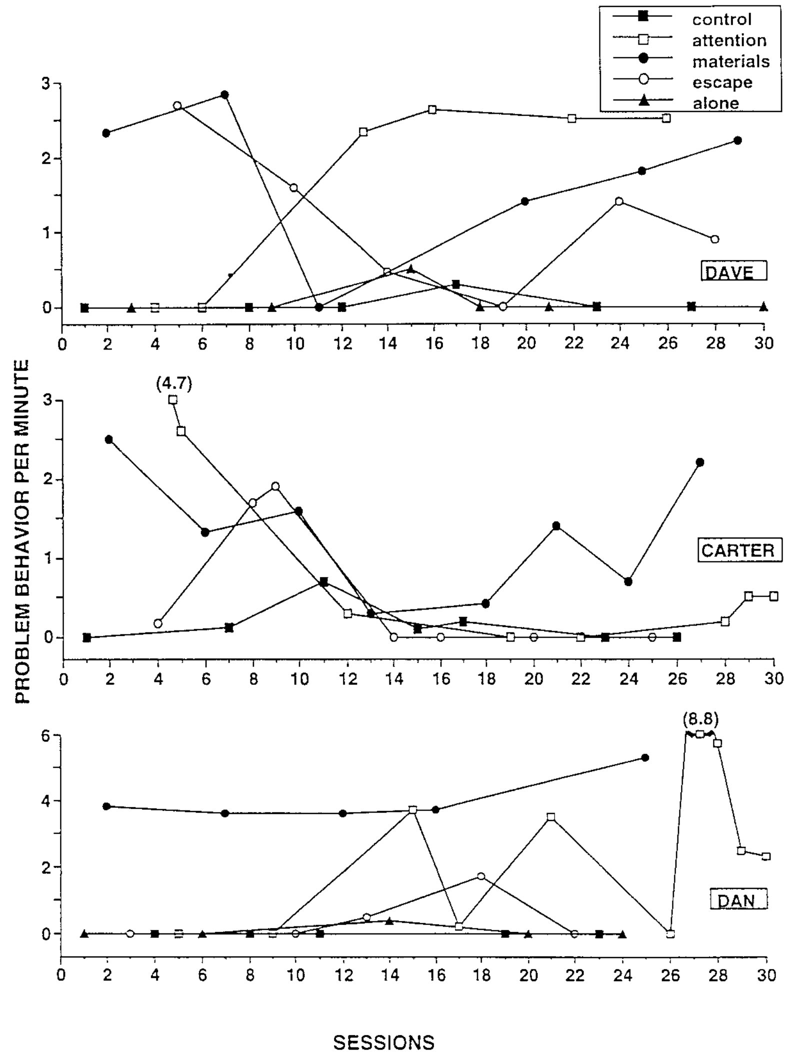

Figure 1. Number of responses per minute of problem behavior (SIB, aggression, disruption) during functional analyses for Dave (upper panel), Carter (center panel), and Dan (lower panel).

SIB and aggression) are combined because they occurred at near equal rates per session (see Table 1). Findings were variable but similar for each participant, in that problem behavior occurred most frequently in the attention and materials conditions. Problem behavior also occurred during the escape condition for Dave but occurred infrequently during this condition for Carter and Dan. Problem behavior occurred rarely in the alone and control conditions. These findings show that participants' problem behavior was sensitive to attention and access to toys as reinforcers.

PHASE 2: ASSESSMENTS TO TEST HYPOTHESES

The functional analysis for each participant showed variable rates of problem behavior during both the attention and the materials conditions. However, the functional analyses were conducted with only 1 par-

Table 1
The Mean Number per Minute of the Target Behaviors (with Ranges in Parentheses) During the Functional Analyses

Participant	Condition	Target behaviors: Self-injury	Aggression	Disruption
Dave	Control	0.1 (0–0.3)	0	
	Attention	1.0 (0–1.8)	0.6 (0–1.2)	
	Materials	1.1 (0–2.5)	0.6 (0–0.8)	
	Escape	0.5 (0–1.0)	0.7 (0–1.7)	
Carter	Control		0.1 (0–0.2)	0.1 (0–0.5)
	Attention		0.5 (0–2.0)	0.7 (0–2.7)
	Materials		0.5 (0–1.0)	0.7 (0.3–1.5)
	Escape		0.2 (0–0.9)	0.3 (0–1.0)
Dan	Control	0	0	
	Attention	1.7 (0–5.8)	1.2 (0–3.0)	
	Materials	2.2 (1.6–3.0)	1.8 (1.5–2.3)	
	Escape	0.3 (0–1.0)	0.2 (0–0.7)	

ticipant and one adult present. Previous research has shown that the presence of another child may alter behavioral function (Asmus, Derby, Wacker, Porter, & Ulrich, 1993) by signaling the availability of potential reinforcers. Therefore, we conducted additional assessments that included a second child (always paired with the same participant) in the room. The second child was of similar age (range, 2 to 4 years) and shared the same living quarters and classroom as the participant. This provided a situation similar to that observed in the descriptive analysis in which a participant was observed playing with a sibling and his parent. Therefore, the objective of this phase was to test the problem behavior's sensitivity to adult attention or toys as potential reinforcers when another child was present, first when only one reinforcer was available per condition and then when the reinforcers were available concurrently.

Experimental Designs and Sequence

We assessed participants' problem behavior first via a modified functional analysis with a multielement design and then with a concurrent-schedule (Catania, 1992) design. In the multielement design, each condition (control, attention, materials) was associated with a specific therapist and room. In the concurrent-schedule design, participants' problem behaviors were associated with a specific reinforcer (i.e., either attention or a toy). For example, in the first phase of the concurrent-schedule assessment for Dave, SIB produced attention and aggression produced access to the other child's toy. These pairings were reversed (i.e., SIB produced a toy, and aggression produced attention) in the second phase of the assessment.

Procedure

Modified functional analysis. In the attention condition, the therapist brought the participant and another child into a room, provided the participant with a requested toy, and interacted with the other child. Contingent on each occurrence of the participant's problem behavior (SIB, aggression, or disruption), the therapist provided a disapproving comment. If the participant requested attention appropriately, the therapist said, "I cannot play now, I am talking to [the other child's name]." The objective of this condition was to assess the problem behavior's sensitivity to adult attention as a reinforcer; therefore, the other child did not have a toy. In the materials condition, the therapist brought the participant and another child into a room, provided toys to both children, and interacted with the participant. The toys provided to the children were identical (to control for quality of reinforcement) and were selected by the participant. Contingent on each occurrence of the participant's problem behavior, the therapist provided him with the other child's toy for 30 s. The objective of this condition was to assess the problem behavior's sensitivity to tangible reinforcement (i.e., toys). Procedures in the control condition were the same as in the control condition of the initial functional analysis.

Concurrent-schedule assessment. Participants' problem behaviors were arbitrarily paired with only one reinforcer (e.g., SIB produced attention and aggression produced access to the other child's toy). The therapist brought the participant and another child into a room, provided both children with toys (as in the materials condition of the modified functional analysis), and interacted with the other child. Contingent on each occurrence of the participant's problem behavior, the therapist provided either a disapproving comment or access to the other child's toy for 30 s according to the concurrent schedule's pairings. If the participant requested attention appropriately, the therapist responded as in the attention condition of the modified functional analysis. When stable findings for each behavior occurred, the reinforcers matched to each behavior were switched to determine whether changes in rate of responding also occurred.

Results

Findings from the modified functional analysis for each participant are presented in the left panels of Figure 2. Data patterns are similar for the 3 participants; problem behavior occurred at high rates in the attention and materials conditions and rarely in the control condition. Thus, the findings show that both adult attention and access to toys continued to maintain problem behavior when another child was present.

Results of the concurrent-schedule assessment for each participant are depicted in the right panels of Figure 2. In the first phase (SIB produced attention, and aggression produced a toy), Dave engaged in higher rates of SIB (M = 1.6 per minute) than aggression (M = 0.9 per minute). When the contingencies were reversed, SIB was initially higher (Sessions 9 through 11); however, aggression occurred at higher rates during the last five sessions. These data suggested that attention was more preferred than toys for both behaviors.

In the first phase of Carter's concurrent-schedule assessment, aggression produced the toy and disruptions produced attention. His findings showed that aggression initially occurred at higher rates (Sessions 1 through 3); however, in Sessions 4 through 10 disruptions occurred more frequently. When the contingencies were reversed, rates of problem behavior were variable, but by the last four sessions aggression occurred more frequently. These data identified attention as being more preferred than toys for both behaviors.

Dan's data show consistently higher rates of aggression (toy) than SIB (attention) in the first phase of the concurrent-schedule assessment. This response pattern was quickly reversed in the second phase, with SIB occurring more frequently when it produced the toy and aggression produced attention. These findings suggested that access to the toy was preferred over attention for both behaviors.

PHASE 3: TREATMENT EVALUATION

Treatment for each participant was based on reinforcer preference as identified through the concurrent-schedule assessment. The effects of treatment for the preferred re-

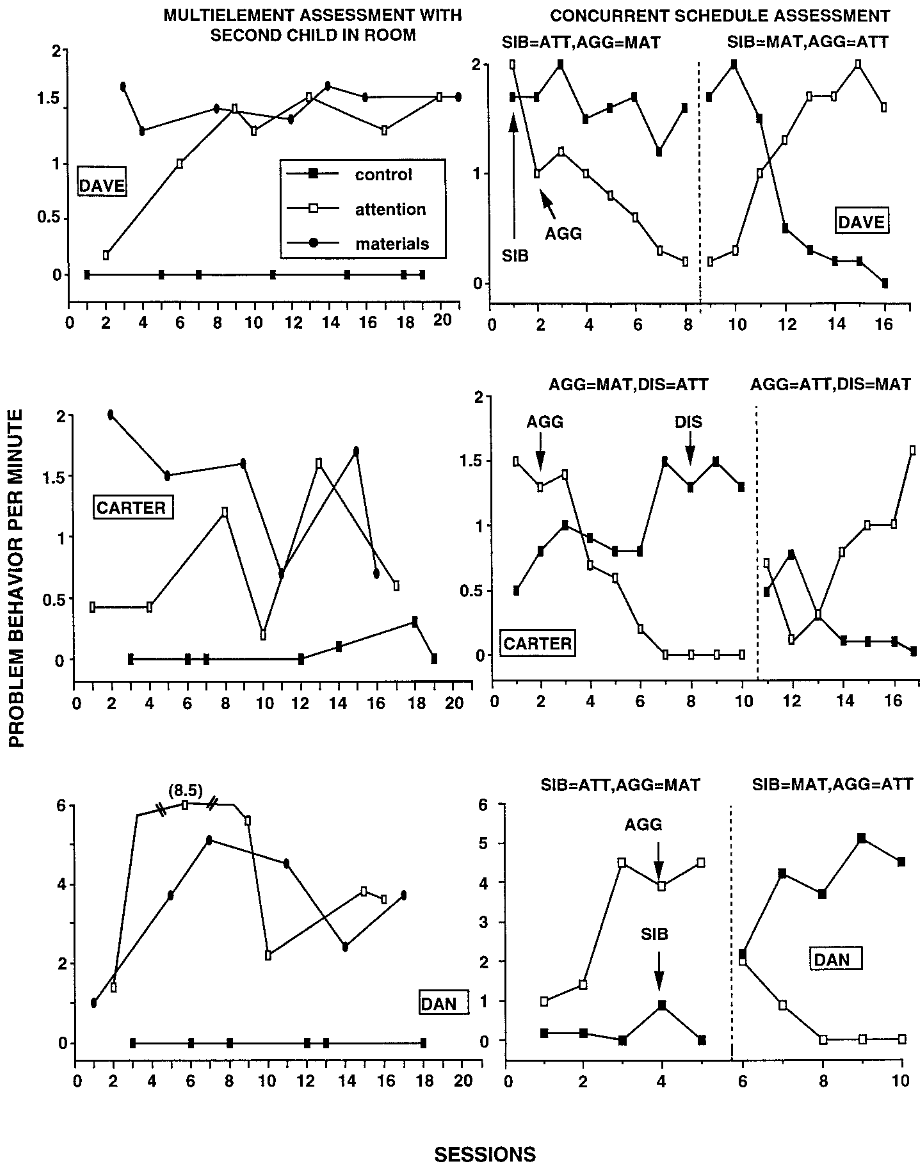

Figure 2. Number of responses per minute of problem behavior during the modified functional analyses (left panels) and the concurrent-schedule assessments (right panels) for each participant. Agg = aggression, Dis = disruption, Att = attention, Mat = materials.

inforcer were assessed during conditions in which an adult and 2 children (playing with toys) were present. Treatment for problem behavior that occurred in other conditions during the participants' initial and modified functional analyses (e.g., escape for Dave) was conducted, but the results are not presented here.

Procedure

Baseline. Baseline procedures were the same as those described in the modified functional analysis attention condition for Dave and Carter and the materials condition for Dan.

Treatment for attention-maintained problem behavior: Extinction plus noncontingent *reinforcement.* Dave's and Carter's concurrent-schedule assessments identified attention as the preferred reinforcer; therefore, procedures were designed to address an attention function. The therapist brought the participant and another child into a room, provided the children with toys, and before interacting with the other child, said to Dave or Carter, "You play with this toy while I talk to [other child's name]." The therapist provided noncontingent attention (NCR) on an FT 60-s schedule. The interaction lasted 30 s and consisted of the therapist modeling and praising appropriate toy play. We did not thin the NCR schedule because we wanted to ensure a rich schedule of interaction throughout the session. The therapist did not respond to problem behavior during these conditions.

Treatment for problem behavior maintained by access to tangible reinforcement: Extinction, noncontingent reinforcement, and choice (of alternative toys). Dan's concurrent-schedule assessment showed that access to toys was preferred. The therapist brought the participant and another child into a room and provided the children with toys (as in the materials condition of the multiple-schedule assessment) and said, "You have to take turns playing with the toys. When the timer rings, it's [the other child's name] turn." On an FT 60-s schedule (signaled by the timer), the therapist said to the children, "Do you want to switch toys?" If a child said yes, the therapist provided immediate access to the other child's toy while providing that child with a choice of another preferred toy (from a three-toy array). The toys were identified as preferred using the methodology described by Fisher et al. (1992). If the children did not want to switch, the therapist reset the timer for 60 s. If Dan asked for the other child's toy before the FT interval expired, the therapist said, "You have to wait for your turn." The therapist interacted individually with each child for 30 s (modeling and praising appropriate toy play) during the FT interval. Problem behavior did not produce access to the other child's toy during this condition.

Parent training. Following the treatment evaluation, each participant's mother was trained to use the relevant procedures. Vocal and written instructions, modeling, role playing, and feedback were used to train the parents.

Results

The results of the treatment evaluations for each participant are presented in Figure 3. Dave's problem behavior averaged approximately 1.5 per minute in the initial baseline phase. When treatment was introduced, rates of problem behavior quickly reached zero (Sessions 7 and 8); however, we observed a temporary increase in rates (Sessions 9 through 13) before they returned to zero. Rates of problem behavior in the second baseline phase (M = 1.1 per minute) were similar to those in the initial baseline. We observed an immediate reduction in rates with the reintroduction of treatment. Parent training data show an initial increase in problem behavior that eventually reached zero.

Carter's baseline rates of problem behavior averaged approximately 2.6 per minute (Figure 3). Rates of problem behavior during the initial treatment phase showed a substantial decrease that quickly reached zero (M = 0.4). Rates of problem behavior during the second baseline phase (M = 3.0 per minute) were similar to those in the initial baseline phase and quickly decreased to zero in the second treatment phase. Parent training data showed an initial increase in rates of problem behavior before they gradually reached zero (M = 1.0 per minute).

Dan's data show that problem behavior averaged approximately 5.4 per minute during the initial baseline with a substantial reduction when treatment was introduced (M

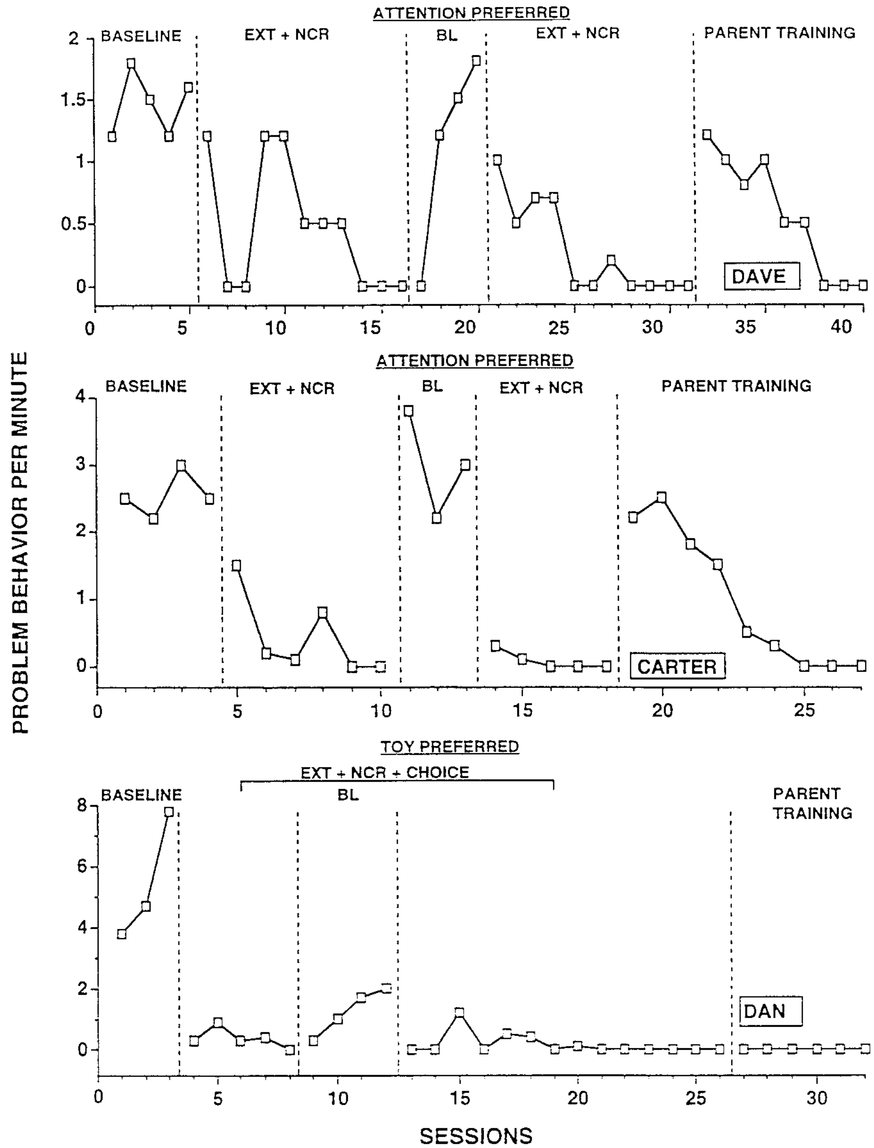

Figure 3. Number of responses per minute of problem behavior during baseline (BL), extinction (EXT) plus noncontingent reinforcement (NCR) for David (upper panel) and Dan (lower panel), and EXT plus NCR plus choice for Carter (center panel).

= 0.4 per minute) (Figure 3). Rates of problem behavior in the second baseline (M = 1.3 per minute) were lower than those in the initial baseline but showed an upward trend. The reintroduction of treatment showed an immediate reduction in the target behavior (M = 0.2 per minute). Parent training data showed that rates of problem behavior remained at zero throughout the remainder of the study.

DISCUSSION

We used functional analyses and concurrent-schedule assessments to identify the behavioral functions of problem behavior that occurred in the presence of multiple maintaining stimuli. Situations that were predictive of problem behavior consisted of a participant and another child playing with toys with an adult present. Thus, it was unclear whether problem behavior functioned to obtain adult attention, the other child's toy, or both. In Phase 1, functional analyses (Iwata et al., 1982/1994) showed that each participant's problem behavior was variably sensitive both to adult attention and to access to toys as reinforcers. In Phase 2, modified functional analyses with another child present produced undifferentiated responding across attention and materials conditions. However, the concurrent-schedule assessments showed that 2 participants preferred attention and that the 3rd participant (Dan) preferred access to toys as reinforcers for both topographies of problem behavior. In Phase 3, treatments were developed based on the concurrent-schedule assessments, with the results showing that the treatments effectively reduced rates of problem behavior.

Our findings support previous research that showed the benefit of conducting additional analyses when behavioral function (i.e., social reinforcement) or the source of stimulation (i.e., nonsocial reinforcement) was not clearly identified during initial assessments. For example, Vollmer, Marcus, Ringdahl, and Roane (1995) showed the utility of progressing from brief to extended analyses when behavioral function was not clearly identified. Vollmer at al. progressed through four phases of analysis with certain participants to obtain differentiated response patterns (suggesting behavioral function). Results showed that 10 of 20 participants required extended analyses (past Phase 2) to identify behavioral function. An operant function was identified for 7 of the 10 participants either in Phase 3 (5 participants) or in Phase 4 (2 participants) of the study.

Other researchers have conducted assessments following initial functional analyses to help to identify potential sources of stimulation for responses that were maintained by nonsocial reinforcement (e.g., Goh et al., 1995; Lalli, Livezey, & Kates, 1996). For example, after functional analyses showing that hand mouthing was maintained by automatic reinforcement, Goh et al. conducted assessments with 4 participants to identify the specific reinforcing properties of the response (i.e., either mouth or hand stimulation). Each participant was provided with a toy, and hand–toy contact and mouth–toy contact was measured as a preference for hand or mouth stimulation. Results showed that hand stimulation was the preferred reinforcer for all participants.

The present study has important clinical implications for the assessment of problem behavior in the presence of multiple stimuli. The concurrent-schedule assessments resulted in differentiated responding across response topographies, thus suggesting that response allocation was influenced by reinforcer quality (i.e., attention vs. toys; Peck et al., 1996). Differentiated responding was observed when we assessed problem behavior during a concurrent-schedule procedure, thus providing a methodology for assessing reinforcer preference in the presence of multiple controlling stimuli. Our findings suggest the need for functional analyses with both single and concurrent operants to identify reinforcer preference when multiple reinforcers may be operating in the natural environment.

A potential limitation of the present study was the rich FT (60 s) schedule of reinforcement. This schedule may be difficult to maintain over extended periods in the participants' homes; therefore, future studies may wish to assess treatment with leaner FT schedules. Another concern was the initial burst in Dave's and Carter's problem behavior when parent training was introduced. The high rates of problem behavior with the parents were observed after several sessions of low to zero rates with the therapists. Because the parents were using the treatment procedures correctly, these findings suggest that stimulus control may be an explanation for the initial high rates of problem behavior with the parents. Future studies may assess the effects of pairing parents with a therapist at the start of parent training and gradually fading the therapist's presence once behavioral control is obtained.

Overall, these results suggest that a concurrent-schedule assessment should be conducted when at least one topography of problem behavior appears to be multiply controlled. For example, when problem behavior occurs during an instructional activity and is followed by both peer attention and escape from the task, a concurrent-schedule assessment may help to clarify specific maintaining variables. Positive and negative reinforcement hypotheses can be tested by pairing individual therapists with a potential reinforcer (i.e., attention, escape). It is our hope that the current study will stimulate future applications of a concurrent-schedule assessment.

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STUDY QUESTIONS

1. The authors noted that typical functional analyses involve manipulation of both establishing operations and consequences. Why is it important to manipulate both variables?

2. What were the dependent variables of interest in the study?

3. In what way were the results of the descriptive analysis ambiguous?

4. What were the main differences between the functional analyses used in Phases 1 and 2?

5. Briefly describe the rationale, procedures, and results obtained from the concurrent-schedules phase.

6. How did the treatment procedures differ across participants, and what results were obtained?

7. Suppose that the treatments used for Dave and Carter were used for Dan, and vice versa. What would be the expected results and why?

8. What is a limitation involved in using the concurrent-schedules design to identify the specific variables that are responsible for behavioral maintenance? How could this problem be resolved by altering either the assessment or treatment?

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